

Current Safety Practices Relating to I-131 Administration for Diseases of the Thyroid: A Survey of Physicians and Allied Practitioners

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Background: There is little information about the individual safety instructions provided by healthcare professionals to patients receiving radioactive iodine (I-131) therapy for the treatment of benign and malignant thyroid disorders or about whether these instructions are consistent across medical specialties. Currently, no national guidelines exist to standardize safety instructions related to I-131 administration. Here, we examine the spectrum of I-131 safety practices in contemporary use.

Methods: Members of major societies of physicians and allied specialists who treat patients with thyroid disorders were invited to complete a 27-question online survey about safety practices related to I-131 administration. Data from questionnaires were analyzed by type of safety recommendation and grouped according to provider specialty and geographic location.

Results: A total of 311 endocrinologists, surgeons, nuclear medicine radiologists, and allied health professionals completed questionnaires. They indicated that patients often receive instruction from more than one treating specialist. The decision to hospitalize a patient for treatment and the length of stay were determined by the patient's social situation and the dose of I-131 administered. Starting at I-131 doses between 259 and 1073 MBq (7 and 29 mCi), over 60% of respondents advised avoiding contact with children, sexual activity, and breastfeeding, with the latter recommendation continuing beyond 48 hours after treatment. Personal hygiene, laundry, and meal preparation precautions varied across respondents. Over 90% of respondents used serum or urine testing to screen for pregnancy status. Precautions to delay parenthood were given more often to female than male patients (90% vs. 60%), with a minimum recommended delay of 6 months. About 20% of respondents considered insurance coverage as a factor in selecting outpatient versus inpatient I-131 therapy, and this consideration varied geographically.

Conclusion: A wide variety of safety recommendations are given to patients who receive I-131. To our knowledge, this survey represents the first organized inquiry into safety practices related to I-131 administration. The diversity of responses suggests an opportunity for multispecialty collaboration in defining more uniform recommendations for patient safety instructions during and after I-131 treatment.

Introduction

IN 2006, THE AMERICAN THYROID ASSOCIATION (ATA) prepared a Position Commentary in response to a challenge to the U.S. Nuclear Regulatory Commission's guidelines for public safety regarding exposure to patients treated with radioactive iodine (I-131) (1). During the preparation of that commentary, it became apparent that great diversity existed

in the safety precautions recommended by the ATA committee members to patients receiving I-131. Precautions varied from very minimal to very rigorous procedures, the choice of which appeared to be based on tradition, local regulations, level of personal concern, and payers' acceptance or denial of certain procedures. A survey was conducted to identify the safety advice most commonly provided to patients and to quantify the differences among current practices.

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The primary objective of the survey was to elicit information concerning recommendations for I-131 safety protocols for patients treated for hyperthyroidism, goiter, and thyroid cancer. A secondary objective was to identify differences in recommendations due to geographical location or professional association. The overall goal was to obtain a measure of clinical safety practices related to I-131 treatment. To our knowledge, this is the first survey of its kind to capture contemporary clinical practices. Our hypothesis was that these practices vary widely with clinician specialty. In reporting existing practices, we proposed to determine whether these practices illustrate a need for the development of a common set of safety precaution recommendations to be provided to patients, their families, and caregivers following I-131 therapy, because these are lacking in published literature (2–8).

Methods

The questionnaire was developed by the members of the ATA Clinical Affairs and Public Health Committees with input from other ATA committees and individual members. The survey consisted of 27 questions across a range of topics, including participant demographics, safety protocols, screening practices, procreation, consent forms, insurance issues, and precautions for isolation, human contact, and hygiene. Respondents were also invited to submit additional general comments, and their personal or institutional example of patient instructions for I-131 treatment. A summary of the questionnaire is provided in Figure 1 and the questionnaire is included as supplementary data S1 (Supplementary Data are available online at www.liebertonline.com/thy).

The questionnaire was included as a hyperlink in an e-mail message to ATA members and to members of the American Association of Endocrine Surgeons, who were encouraged to forward this e-mail to their colleagues. The survey was also presented to the leadership of the Society of Nuclear

Medicine and the American Society for Therapeutic Radiology and Oncology, but, to our awareness, was not distributed further. A link to the survey was placed on the Web sites of The Endocrine Society and the American Association of Clinical Endocrinologists. The survey was hosted by Survey-Monkey.com, an online firm providing questionnaire services, including construction, hosting, and spreadsheet summaries of responses. The responses were collected and maintained anonymously. Duplicate entries or incomplete responses were screened and excluded on the basis of Internet Protocol addresses as a quality control measure. Not all respondents answered every question, and some respondents provided answers more than once. In these cases, only the first response attributable to an Internet Protocol address was included in the analysis. If respondents chose more than one answer for dosing questions, only the lowest dosage chosen was counted. If “Do Not Advise” was selected, only that response was counted. For some analyses, the respondents were divided into subsets based on role. Specifically, the data summarized in Tables 5 and 6 provide the responses of those practitioners who administer or supervise the treatment of I-131, as the respondents who indicated that they only refer patients for therapy did not elect to complete the questionnaire on these topics to allow subset-to-subset comparisons. Also, under each heading of the Results section, any subset analysis according to a provider’s role is addressed directly in the context of the topic being presented.

Because the questionnaire was designed to quantify current practices, the focus of this survey was on the identification, rather than a critical evaluation, of differences. To this end, the statistics provided in the tables were limited to simple counts and percentages relative to the total number of responses for each question. Also, as noted in the Discussion section, because the distribution of the survey was to a broad audience of diverse specialists, it was not possible to quantify a response rate as a percentage of any specific denominator. At the time

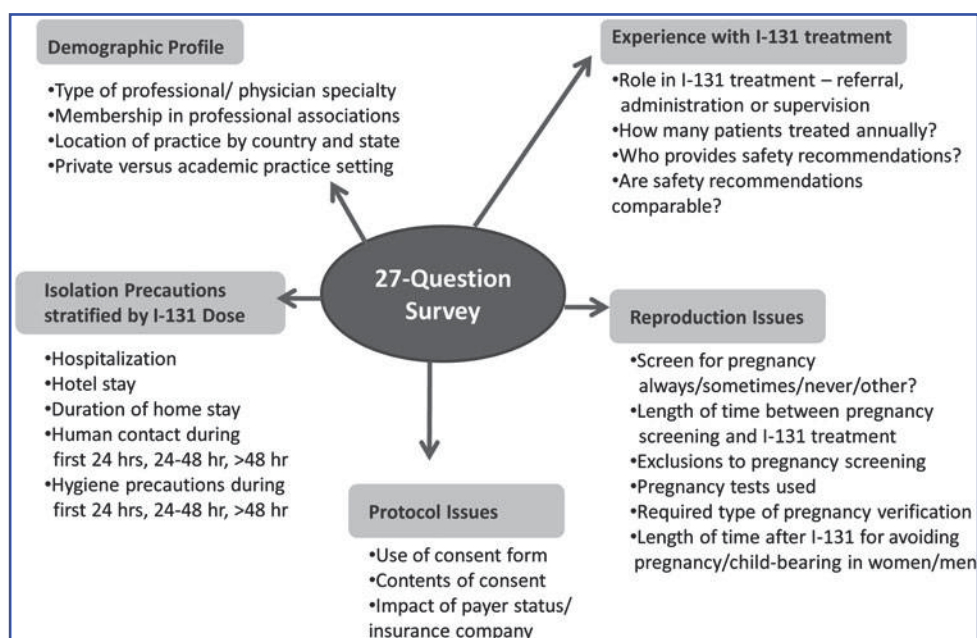


FIG. 1. Contents of the American Thyroid Association (ATA) I-131 safety recommendations survey.

of survey distribution, there were 1300 members in ATA, 311 members in American Association of Endocrine Surgeons, 14,000 members in The Endocrine Society, and 6000 American Association of Clinical Endocrinologists members. It was not known how many clinicians are members of multiple organizations. In addition, some members of each society are engaged in basic research, in nonthyroidal fields (e.g., diabetes), or may not prescribe or be licensed to administer I-131. As no single organization or professional group exists whose membership deals exclusively with clinical practice using I-131, estimating an appropriate denominator was not feasible.

Results

A total of 311 individuals participated in the survey. The number of patients treated annually with I-131 was between 10 and 100 for the majority of respondents (219/311, 70%), with an additional 46 specialists (15%) treating >100 patients annually. Half of the respondents (156/311, 50%) indicated that they personally administer and supervise the I-131 treatment. Most (207/311, 67%) also designated that they themselves provided safety precautions related to I-131 therapy. Responses to questions contingent on the specialty of the practitioner administering or supervising I-131 therapy were analyzed for only those respondents who identified themselves by group, so that the advice tabulated reflected opinions within each treating specialty, rather than that of all specialists who refer patients for I-131 therapy.

Demographic profile of the survey respondents

The majority of respondents (260/311, 84%) identified themselves as physicians and 51 (16%) were nonphysicians. Medical specialties represented by the study respondents included endocrinologists (195, 63%), surgeons (31, 10%), nuclear medicine physicians (27, 9%), and a minority of others (radiation oncology 2, pediatrics 3, unspecified 10). The majority of physicians (62%, 161/260) were affiliated with universities. In contrast, the majority of radiation safety officers (RSOs) were based in private practice (25/39, 66%). Non-physician respondents consisted primarily of RSOs (39, 13%) and rarely of nurse practitioners (1) and radiation safety program coordinators (1).

Most respondents (252/301, 84%; 10 did not specify country of origin) were from North America, and 97% of the RSOs were from the United States (Table 1). At least one endocri-

nologist from each of the geographic locations outside of North America (South America, Europe, Middle East, and Asia) provided a response; not all of these locations were represented in the group of surgeons and nuclear medicine physicians. Professional affiliations identified by study participants reflected their specialties, and many respondents, particularly endocrinologists, were members of multiple associations (Table 2).

Nature of experience with I-131 treatment

Regardless of specialty, most respondents (75%, 219/293) were involved in radiiodine treatment, between 10 and 100 patients annually (Table 3). However, the personal administration or supervision of I-131 for hyperthyroidism, goiter, or thyroid cancer varied depending on physician specialty. Nearly all (93%) of the nuclear medicine physicians and 70% of RSOs stated that they administered or supervised administration of I-131 for hyperthyroidism, goiter, or thyroid cancer, whereas only 50% of the endocrinologists and 10% of the surgeons did so.

Safety instructions pertaining to isolation, human contact, and hygiene

Providers of safety instructions. Responses to the question regarding the source of safety instructions for the patient and family members revealed that the patients received instructions from a variety of sources and often from more than one source. The majority of endocrinologists (85%) provided instruction personally and/or within their practices, but 79% also believed that safety instruction was given to patients in the nuclear medicine department. In contrast, only 42% of surgeons provided instruction personally, which may not be surprising, given that 100% of the surgeons indicated such instruction was provided in the nuclear medicine department and 90% of surgeons identified their role as referring, rather than directly treating, patients with I-131. Similar to the endocrinologists, a high proportion of nuclear medicine physicians provided instructions either personally or within their nuclear medicine department (21/27, 78%), with an additional 37% (10/27) expecting further patient guidance from RSO. The responses from RSOs revealed that 72% (28/39) provided safety instruction to patients within their departments, and 74% of RSOs anticipated that radiation safety instruction would also be provided by the nuclear medicine

TABLE 1. GEOGRAPHIC LOCATIONS OF 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Geographic area	Endocrinologist		Nuclear medicine		Surgeon		RSO		Other	
	n	%	n	%	n	%	n	%	n	%
North America										
United States	148	76	19	70	25	81	38	97	7	70
Canada	6	3	2	7.5	0	0	0	0	0	0
Mexico	5	3	2	7.5	0	0	0	0	0	0
Other ^a	35	18	4	15	6	19	1	3	3	30
Total ^b	194		27		31		39		10	

^aThe category "Other" included South America, Europe, Middle East, and Asia.

^bAll respondents did not answer every question; 10 respondents did not state a country of origin. RSO, radiation safety officer.

TABLE 2. PROFESSIONAL ASSOCIATION AFFILIATIONS OF 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Professional association	Endocrinologist		Nuclear medicine		Surgeon		RSO		Other	
	n	%	n	%	n	%	n	%	n	%
American Thyroid Association	116	60	6	22	11	36	0	0	3	30
American Association of Clinical Endocrinologists	130	67	0	0	13	42	0	0	2	20
The Endocrine Society	156	80	1	4	5	16	0	0	4	40
American Association of Endocrine Surgeons	0	0	0	0	26	84	0	0	0	0
Society of Nuclear Medicine	6	3	26	96	0	0	10	26	1	10
American Society for Therapeutic Radiology and Oncology	1	0.5	1	4	0	0	3	8	1	10
Other professional association	34	17	6	22	6	19	34	87	1	10
Total number of physicians ^a	194		27		31		39		10	

^aAll respondents did not answer every question; 10 respondents did not state professional association. *n*, number of physicians who indicated they were members of the association in question.

department. Of practitioners who indicated that, in their clinical setting, more than one specialist provides safety instructions to patients and their family members, the majority perceived that the recommendations from these sources were comparable (Table 4). The proportion of those who indicated that recommendations were comparable, however, varied according to specialty type (Table 4A) and whether the practitioner administers I-131 treatment (Table 4B). Of note, 3%–11% indicated that recommendations were not comparable, up to 16% did not know whether they were comparable, and up to 45% provided written comments that could not be readily categorized, but rather expressed broadly what the specialists do in their practice.

Isolation precautions. To ascertain isolation precautions for radioiodine treatment, survey questions asked were at what dose and for how long patients were required to be hospitalized, quarantined at home, and/or to stay at a hotel.

One-quarter (23%) of respondents indicated that they did not use doses in the range between 7400 and 11,063 MBq (200–299 mCi), and 50% indicated that they did not use a dose of 11,100 MBq (300 mCi) I-131 or higher. At or below 1110 MBq (30 mCi), 72/104 (69%) of the respondents stated they never hospitalize their patients (Fig. 2). At higher I-131 doses, proportionally fewer specialists never hospitalize (28% at dose 1147–3663 MBq [31–99 mCi]; 15% at dose 3700–7363 MBq [100–199 mCi]; 6% at dose 7400–11,063 MBq [200–299 mCi]). Similarly, the percentage of specialists who specified a duration of hospital stay increased with increasing doses of administered I-131 (5% at doses <1110 MBq [<30 mCi]; 19%

at dose 1147–3663 MBq [31–99 mCi]; 20% at dose 3700–7363 MBq [100–199 mCi]; 30% at dose 7400–11,063 MBq [200–299 mCi]; 32% at dose >11,100 MBq [>300 mCi]). However, across all dose ranges, specialists frequently stated that the decision to hospitalize depended on the social situation; the ATA questionnaire did not elaborate on what defines social situations in these circumstances, and neither did the respondents. Likewise, for those recommending hospitalization for doses over 3700 MBq (100 mCi), the length of stay was dependent on patient radioactivity measurements, according to 30% of respondents.

Recommendations for quarantine at home showed the following patterns: quarantine at home was never recommended by 51% of respondents for I-131 doses ≤ 1110 MBq (≤ 30 mCi) and by 34% administering doses between 1147 and 3663 MBq (31–99 mCi). For respondents who recommended that patients stay at home following treatment, the amount of time recommended for staying at home increased progressively from <1 day to 72 hours, as the dose of radioiodine increased beyond 7400 MBq (200 mCi).

Recommendations for a hotel stay to avoid contaminating the home were rarely made: over 80% of respondents never recommended a hotel stay for dose ranges below 11,063 MBq (299 mCi). This was corroborated by several questions that incorporated a choice for hotel stay.

Human contact precautions. Ten questions focused on recommendations about human contact distance precautions following radioiodine treatment, with duration options of 24, 24–48, or >48 hours after I-131 therapy. Responses indicated

TABLE 3. NUMBERS OF PATIENTS TREATED OR REFERRED FOR I-131 TREATMENT BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Physician type	<10		10–100		>100		Total ^a
	n	%	n	%	n	%	
Endocrinologist	14	7	152	79	26	14	192
Nuclear medicine	2	7	15	56	10	37	27
Surgeon	4	13	27	87	0	0	31
Radiation safety officer	5	14	21	58	10	28	36
Other	3	43	4	57	0	0	7

^aAll respondents did not answer every question: 293 of 311 responded to this question.

TABLE 4. RESPONSES TO THE QUESTION "ARE SAFETY RECOMMENDATIONS FROM MULTIPLE SOURCES COMPARABLE?" BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

(A) Responses Grouped by Specialty

Physician type	Yes		No		Don't know		Other		Total ^a
	n	%	n	%	n	%	n	%	
Endocrinologist	123	77	10	6	13	8	14	9	160
Nuclear medicine	15	88	1	6	1	6	0	0	17
Surgeon	10	50	1	5	0	0	9	45	20
Radiation safety officer	24	86	3	11	0	0	1	3	28
Other	5	72	0	0	1	14	1	14	7

^aAll respondents did not answer every question: 232 of 311 responded to this question.

(B) Responses Grouped by Whether Practitioner Administers or Supervises I-131 Treatment

Role in I-131 treatment	Yes		No		Don't know		Other		Total ^a
	n	%	n	%	n	%	n	%	
Does not administer or supervise I-131 treatment	73	69	11	10	17	16	5	5	106
Administers or supervises I-131 treatment	97	83	4	3	7	6	9	8	117

^aAll respondents did not answer every question: 223 of 311 responded to this question.

that there was little to no difference in the recommended precautions as the time from I-131 treatment increased (Table 5 provides responses for the first 24-hour interval).

Most respondents (84/105, 80%) recommended avoiding children under age 2 for the first 24 hours following treatment, beginning at doses of radioiodine <1110 MBq (<30 mCi). A further 12% recommended this avoidance for all doses at or above 1110 MBq (30 mCi). In addition, starting at the lowest dose range of 259–1073 MBq (7–29 mCi), over 60% of respondents recommended avoiding children under age 10 years, sexual contact, and breastfeeding. They also advised sleeping alone, maintaining a specific distance from people, and maintaining specific time/distance exposures, that is, the length of time a person could spend within a certain distance from a treated patient. Our questionnaire did not elicit what those time/distance instructions were for each respondent.

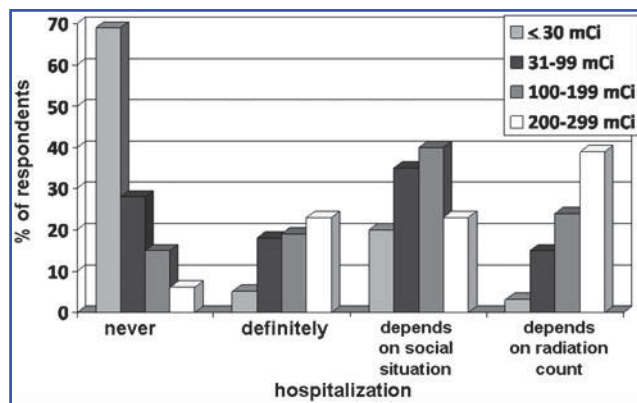


FIG. 2. Type of isolation precautions according to treatment dose of I-131. The recommendation for hospitalization includes any length of hospital stay. Dose of I-131 expressed in MBq are as follows: <1110 MBq (30 mCi); 1147–3663 MBq (31–99 mCi); 3700–7363 MBq (100–199 mCi); and 7400–11,063 MBq (200–299 mCi).

Half of the respondents (49/106, 46%) recommended avoiding public transportation following doses of radioiodine <1110 MBq (<30 mCi).

Half of the respondents recommended the same precautions for the first 48 hours following treatment as for the first 24 hours after treatment. Except for breastfeeding, contact precautions beyond 48 hours were deemed to be unnecessary by two to three times as many respondents as in the earlier hours following treatment. Half of the respondents continued to recommend avoidance of breastfeeding on the third day posttreatment (over 48 hours).

At all time points, over 80% of respondents stated that they did not advise the patients to stay in a hotel and did not recommend potassium iodide (KI) for family members.

Hygiene precautions. Eight questions involved hygiene precautions following radioiodine treatment, including recommendations regarding laundry and dental habits as well as food preparation. Fewer respondents indicated that they offer advice on toothbrush disposal and use of gloves for food preparation, compared with other precaution categories.

The hygiene precautions listed in Table 6 summarize provider advice for the first 48 hours after any level of I-131 treatment. The percentage of respondents who recommended any one of the eight hygiene precautions was greater, by margins of 1.3 or more, for those who actually administer or supervise I-131 treatment, compared with any other practitioners. Approximately half of those who offered hygiene precautions in the first 24 hours following treatment did not continue these precautions beyond 48 hours for patients who had received I-131 in the dose range of 259–1073 MBq (7–29 mCi).

Precautions relating to reproduction

Pregnancy screening practices. Most respondents (151/168, 90%) indicated that they always screen for pregnancy

TABLE 5. RECOMMENDED HUMAN CONTACT PRECAUTIONS FOR THE FIRST 24 HOURS AFTER I-131 TREATMENT PROVIDED BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Recommendation	n ^a	259–1073 MBq (7–29 mCi)	All doses ≥1110 MBq (≥30 mCi)	All doses ≥3700 MBq (≥100 mCi)	All doses ≥7400 MBq (≥200 mCi)	Do not advise
Avoid public transport?	106	49 (46.2%)	34 (32%)	10 (9.4%)	1 (1%)	12 (11.3%)
Avoid children <Age 2?	105	84 (80%)	19 (18%)	0 (0%)	1 (1%)	1 (1%)
Ages 2–10?	103	69 (67%)	24 (23%)	3 (3%)	1 (1%)	6 (6%)
Maintain a specific distance with people?	103	64 (62%)	23 (22%)	7 (7%)	1 (1%)	8 (8%)
Maintain a specific time/distance exposure? ^b	103	68 (66%)	17 (17%)	7 (7%)	2 (2%)	9 (9%)
Stay in a hotel?	91	4 (4%)	6 (5%)	2 (2%)	3 (3%)	77 (85%)
Sleep alone?	104	64 (62%)	22 (21%)	10 (10%)	3 (3%)	5 (5%)
Avoid sexual contact?	101	69 (68%)	17 (17%)	7 (7%)	2 (2%)	6 (6%)
Avoid breast feeding?	89	58 (65%)	6 (7%)	0 (0%)	1 (1%)	24 (27%)
Recommend KI for family members?	94	0 (0%)	4 (4%)	1 (1%)	0 (0%)	89 (95%)

All respondents did not answer every question, and respondents could select multiple answers among the recommendations. If respondents chose multiple dosages, only the lowest dosage selected was counted. If “do not advise” was selected, only that response was counted. For example, most respondents (84/105, 80%) recommended avoiding children under age 2 for the first 24 hours following treatment, beginning at doses of radioiodine between 259 and 1073 MBq (7–29 mCi). Another 18% recommended this avoidance start for all doses at or above 1110 MBq (30 mCi).

^aIncludes only respondents who answered yes ($n = 156$ of 311, 50%) to the question “Do you administer or supervise administration of I-131 for hyperthyroidism, goiter, or thyroid cancer?” All others were excluded (no = 132, 42%; other = 12, 4%; no response = 11, 4%).

^bDefined as a specified length of time during which a person was within a certain distance from a treated patient.
KI, potassium iodide.

before giving I-131, with few doing this only sometimes (16, 9.5%); one respondent never did. Exclusion criteria for screening for pregnancy included hysterectomy (165/207, 80%) and self-report of celibacy (7.2%). In response to an open-ended question regarding pregnancy screening, a few respondents answered that they also did not screen for pregnancy if the patient was clearly postmenopausal or over age 55.

Pregnancy screening was primarily accomplished with a pregnancy test (179/194, 92%). Serum pregnancy tests were most commonly employed by endocrinologists (111/156, 71%), nuclear medicine physicians (14/16, 88%), and RSOs (15/23, 65%). Surgeons primarily reported using urine preg-

nancy tests (8/11, 73%). Few respondents (3.6%) accepted written consent of nonpregnancy status and few also (3.6%) accepted verbal report of nonpregnancy.

The time between performing pregnancy screening and the administration of I-131 was reported to be within 24 hours by 41% (82/198) and within 48 hours by 27% (53/198) of respondents. Few respondents (21/198, 11%) indicated that they treated on the same day the pregnancy test was administered.

Timing of parenthood after I-131. Only a subset of respondents who reported administering or supervising administration of I-131 treatment answered questions relating to

TABLE 6. RECOMMENDED HYGIENE PRECAUTIONS FOR THE FIRST 48 HOURS AFTER I-131 TREATMENT PROVIDED BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Recommendation	n ^a	259–1073 MBq (7–29 mCi)	All doses ≥1110 MBq (≥30 mCi)	All doses ≥3700 MBq (≥100 mCi)	All doses ≥7400 MBq (≥200 mCi)	Do not advise
Wash hands frequently?	102	72 (71%)	11 (11%)	3 (3%)	1 (1%)	15 (15%)
Dispose of toothbrush?	98	30 (31%)	13 (13%)	3 (3%)	1 (1%)	51 (52%)
Wash clothes/bedding separate from family?	101	56 (55%)	20 (20%)	7 (7%)	1 (1%)	17 (17%)
Wash dishes separate from family?	100	53 (53%)	18 (18%)	6 (6%)	1 (1%)	22 (22%)
Do not make food for other people?	98	50 (51%)	19 (19%)	7 (7%)	1 (1%)	21 (21%)
Wear gloves to prepare food?	92	23 (25%)	14 (15%)	4 (4%)	1 (1%)	50 (54%)
Sit to void urine and always flush twice?	95	78 (82%)	19 (11%)	4 (4%)	1 (1%)	2 (2%)
Special precautions if emesis/incontinence occur?	103	69 (67%)	16 (16%)	3 (3%)	1 (1%)	14 (14%)

All respondents did not answer every question, and respondents could select multiple answers among the recommendations. If respondents chose multiple dosages, only the lowest dosage selected was counted. If “do not advise” was selected, only that response was counted.

^aIncludes only respondents who answered yes ($n = 156$ of 311, 50%) to the question “Do you administer or supervise administration of I-131 for hyperthyroidism, goiter, or thyroid cancer?” All others were excluded (no = 132, 42%; other = 12, 4%; no response = 11, 4%).

TABLE 7. RECOMMENDED DELAY TIME BEFORE PREGNANCY FOLLOWING I-131 TREATMENT PROVIDED BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Recommendation	≤1110 MBq (≤30 mCi)	1147–3663 MBq (31–99 mCi)	3700–7363 MBq (100–199 mCi)	7400–11,063 MBq (200–299 mCi)	≥11,100 MBq (≥300 mCi)
Respondents (n) ^a	108	106	106	94	89
1 month	3 (3%)	3 (3%)	1 (1%)	1 (1%)	0 (0)
3 months	14 (13%)	8 (8%)	9 (8%)	7 (7%)	7 (8%)
6 months	57 (53%)	57 (54%)	50 (47%)	36 (38%)	32 (40%)
12 months	20 (19%)	32 (30%)	40 (38%)	41 (44%)	40 (45%)
No routine recommendation	14 (13%)	6 (6%)	6 (6%)	9 (10%)	10 (11%)

^aAll respondents did not answer every question.

recommendations restricting procreation after radioiodine administration (108/156, 69%; Table 7). Of these respondents, fewer provided responses to the questions regarding high-dose-range treatments. The majority of respondents recommended that female patients who received doses below 7400 MBq (200 mCi) wait a minimum of 6 months before attempting pregnancy and at least 1 year for higher doses. At least one-third of these respondents did not make recommendations to their male patients regarding delay times before fathering children (Table 8). When recommendations were made, these were more often to wait for 6 months. The proportion of respondents who chose to recommend a 12-month delay until pregnancy increased incrementally as the dose of I-131 treatment increased (e.g., 19% recommended this for I-131 dose <1110 MBq [<30 mCi], 38% for doses between 3700 and 7363 MBq [100–199 mCi], and 45% for doses at or above 11,100 MBq [300 mCi], as shown in Table 7).

Use of consent forms

More than half (66%) of respondents stated that they use consent forms for I-131 administration (Fig. 3). Most consent forms provided information on pregnancy and breastfeeding avoidance. Information on risk to salivary glands was also present on most consent forms.

Impact of payer status or insurance coverage on I-131 precautions

The influence of insurance coverage on outpatient versus inpatient care was felt to be a factor in decisions by 17% (26/155) of the United States and 20% (7/35) of non-United States

practitioners. The impact of insurance coverage in the United States varied by geographical region (Fig. 4), with those practicing in southern and western states responding that payer insurance had more influence on choices of inpatient versus outpatient I-131 care. The survey was not structured to identify other outcomes related to insurance coverage.

Other geographical and specialty-based variations in I-131 precautions

Although no comprehensive pattern of differences emerged about I-131 safety recommendations, practice patterns varied somewhat across specialty affiliations and geographic locations. Consent forms were more likely to be used by physicians in the United States (72% vs. 38% for all other countries) and by nuclear medicine radiologists (88%) and RSOs (91%) than endocrinologists and surgeons (58% each). Nuclear medicine physicians were more than twice as likely to provide specific recommendations to male patients about delaying child-bearing and more likely to advise a longer duration of delay at each of the I-131 dose ranges than were endocrinologists. This difference in recommendations between specialists did not exist for female patients and for either gender of patients among those practicing within compared with outside the United States.

Discussion

This is a unique multidisciplinary survey that addressed the topic of safety-related information provided to patients receiving I-131 treatment for thyroid disorders. It queried how various professionals convey I-131 safety precautions at

TABLE 8. RECOMMENDED DELAY TIME BEFORE FATHERING CHILDREN FOLLOWING I-131 TREATMENT PROVIDED BY 311 RESPONDENTS PARTICIPATING IN THE AMERICAN THYROID ASSOCIATION SURVEY OF I-131 SAFETY RECOMMENDATIONS

Recommendation	≤1110 MBq (≤30 mCi)	1147–3663 MBq (31–99 mCi)	3700–7363 MBq (100–199 mCi)	7400–11,063 MBq (200–299 mCi)	≥11,100 MBq (≥300 mCi)
Respondents (n) ^a	108	106	68	96	91
1 month	6 (6%)	2 (2%)	2 (3%)	2 (2%)	2 (2%)
3 months	14 (13%)	16 (15%)	13 (19%)	10 (10%)	8 (8%)
6 months	36 (33%)	36 (34%)	36 (53%)	30 (31%)	29 (32%)
12 months	8 (7%)	13 (12%)	17 (25%)	17 (18%)	15 (16%)
No routine recommendation	44 (41%)	39 (37%)	38 (56%)	37 (39%)	37 (40%)

^aAll respondents did not answer every question.

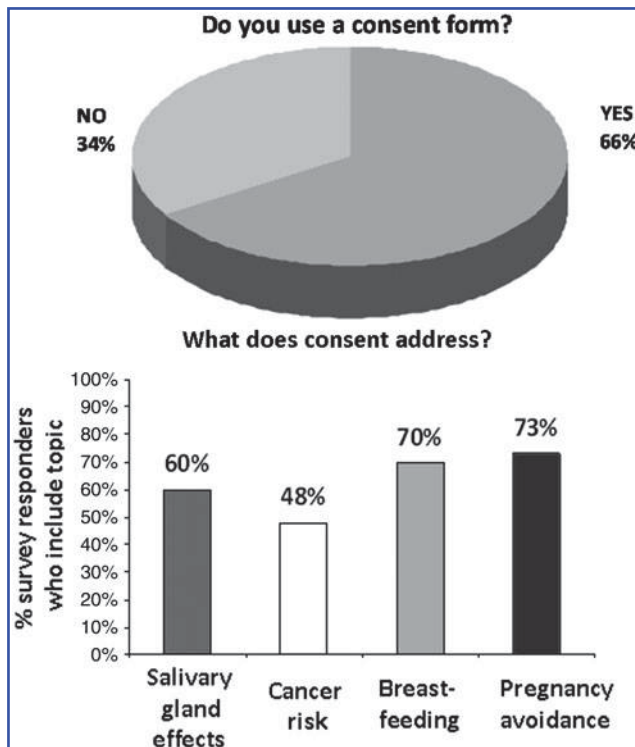


FIG. 3. Use and composition of consent forms for I-131 treatment.

a level of detail that, to our knowledge, had not been accomplished in prior surveys or from predominantly the United States-based clinicians. Only few reports related to I-131 safety practices exist in the literature, some conducted in Europe with more limited scope of questions, smaller respondent numbers, and less multidisciplinary breadth (9,10). Based on the survey responses, our hypothesis was not rejected: I-131 safety practices do indeed vary widely. Radiation safety instruction is presently available from a variety of sources, and patients often receive information from more than one source. In this study, we confirmed the perception from prior work (2,11,12) that notable differences in recom-

mendations exist nationally among the various professionals involved in the therapeutic administration of I-131. Our analysis showed that most survey respondents provided little consistency in practice patterns and radiation safety recommendations from various sources, suggesting the potential for patient and staff confusion. It may seem reasonable to expect that, as the surgeons' responses imply, all instruction ultimately resides with a nuclear medicine department. But clearly, neither the nuclear medicine radiologists nor the RSO responders indicated that this actually occurs. Our questionnaire was not structured to confirm who ultimately does provide such safety instruction.

An area of significant concern to patients receiving I-131 therapy is the site where that treatment will occur. Our survey showed that hospitalization was rarely recommended for I-131 doses ≤ 1110 MBq (≤ 30 mCi). Hospitalization recommendations were also influenced by the type of insurance coverage and varied by geographic region within the United States. For the dose range 1147–7363 MBq (31–199 mCi), the recommendation to hospitalize was a function of patient radioactivity measurement and/or social situations, although the survey did not inquire further about the specific thresholds of radioactivity measurement or examples of social situations that prompt the recommendation to hospitalize following I-131 treatment.

Another broad topic of concern to patients and providers alike is the scope of contact precautions after I-131 treatment. The types of recommendations reported included avoiding children under age 10 years and sexual contact for the first 3 days following treatment, sleeping alone, maintaining a specific distance from people, and limiting time spent with others. More respondents recommended contact precautions during the first 24 and 48 hours posttreatment than at 3 days following I-131 treatment. Avoidance of public transportation was most commonly recommended only for the first 24 hours after treatment. Only 70% of respondents who provided safety precautions provided information to their patients regarding delaying starting a family. Recommendations relative to timing for future conception were given more often and had more consistent precautions when treating women than men. These patterns suggest a real need for defining more consistent and clear recommendations for radiation safety precautions. Such recommendations have the potential to streamline the educational obligations of providers of I-131 treatment, enhance patient understanding, and reduce patient anxiety related to daily activities following I-131 treatment.

Regardless of the administered radioiodine dose level, staying in a hotel was not recommended by the vast majority of respondents. This was determined through two questions, one inquiring about the dose at which a hotel stay was recommended to avoid home contamination and the second through the option of answering "staying in a hotel" as part of human contact precautions; the majority of respondents indicated that they did not advise this step. There is currently no known policy for accommodating such patients that is stated by the American Hotel and Lodging Association (13) and, from anecdotal experiences described during the survey, no mechanism for hotel management to be made aware that a patient with recent I-131 treatment is a guest.

Several limitations of the study can be identified. Respondents were self-selected, based on survey access and motivation to respond. Responses reflected the individual

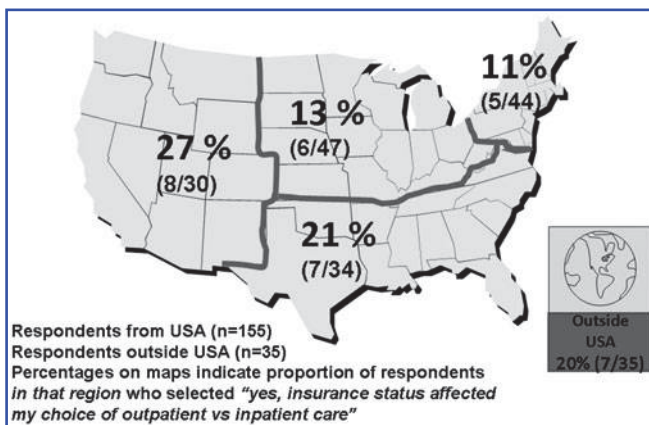


FIG. 4. Proportion of specialists who indicated that insurance status influenced outpatient versus inpatient therapy with I-131.

practices of respondents, which may not necessarily represent practices of other practitioners involved in radioiodine administration. These survey responses may also not represent best practices for such treatment. We acknowledge that our study, similar to other online surveys, cannot provide an accurate total denominator of individuals who received the questionnaire but did not complete or return it. The enormous membership rosters of the societies that received this questionnaire preclude this calculation and also make it cumbersome to model nonresponse bias in our study. This is the first survey of its kind, with over 300 respondents from a variety of disciplines, reflecting the interest and the reality of multidisciplinary involvement with I-131 treatment. The study provides a cross-sectional view of the I-131 safety instructions in use today, with enough responses to reflect the wide variation in I-131 safety practices. Although the study addressed dose ranges for radioiodine, no distinction was made between treatments for hyperthyroidism, goiter, or thyroid cancer. We did not inquire about recommendations beyond 3 days posttreatment, and it is possible that recommendations against breastfeeding would extend beyond that time as a function of higher treatment dose. Menopause and age were not options provided in the pregnancy screening exclusion question, so it is possible these answers were underrepresented. We also noted that answers to questions involving dose ranges typically yielded fewer responses for the higher dose ranges than the lower ranges, perhaps because respondents assumed their answers involving lower doses extended to the higher doses. A potential weakness of the question regarding staying at home was that it did not differentiate between I-131 dose for outpatient treatment versus inpatient treatment (during which time, elimination and decay of radioisotope was expected during hospitalization). To better define isolation practices in any future study, it would be helpful to specify such details.

In conclusion, we conducted a survey of groups of self-selected respondents involved in the administration of therapeutic I-131. We observed a wide range of safety practices and recommendations and the perception of conflicting information offered to patients. These differences may reflect a lack of best practices based on scientific data. Guidelines reflecting expert opinion, evidence-based decision-making, and further investigation would be useful, and our survey results may provide an opportunity to stimulate development of such recommendations.

Acknowledgments

The authors acknowledge the 2006–2009 American Thyroid Association Clinical Affairs Committee, Public Health Committee, and Radioactive Iodine Best Practices Task Force members and administrative staff for their contributions.

Disclosure Statement

The authors declare that no competing financial interests exist.

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Appendix: American Thyroid Association I-131 Safety Recommendations Questionnaire

1. What type of professional are you? (endocrinologist, nuclear medicine physician, radiation oncologist, surgeon, pediatrician, internist, family practitioner, nurse practitioner, physician's assistant, other-please specify)
2. Which professional associations do you belong to? (American Thyroid Association, American Association of Clinical Endocrinologists, The Endocrine Society, American Association of Endocrine Surgeons, Society of Nuclear Medicine, American Society of Therapeutic Radiology and Oncology, other-please specify)
3. In what state/country do you practice?
4. Do you refer patients with hyperthyroidism, goiter, or thyroid cancer to receive radioactive iodine? (yes/no/other)
5. Do you administer or supervise administration of I-131 for hyperthyroidism, goiter, or thyroid cancer? (yes/no/other)
6. Please select the setting that you practice in? (academic/university environment, "pure" private practice, private practice with adjunct university appointment, other-please specify)
7. How many patients a year do you treat with I-131 or refer for I-131 treatment? (<10, 10–100, >100)
8. Who provides the safety instructions to the patient/family? Check all that apply. (me/my practice, nuclear medicine department, radiation safety department, other-please specify)
9. If you marked more than one in Q8, are the recommendations/instructions comparable? (yes/no/don't know/other-please specify)

For questions 10–12, the questions were posed in tabular form with the following I-131 dose ranges each having these answer choices: hospitalized 24 hours, hospitalized 48 hours, hospitalized 72 hours, dependent on patient radioactivity measurement, do not use this dose, never hospitalize, depends on social situation, other. A space was also made available for write-in comments.

I-131 dose ranges were ≤ 1110 MBq (30 mCi), 1147–3663 MBq (31–99 mCi), 3700–7363 MBq (100–199 mCi), 7400–11,063 MBq (200–200 mCi), $\geq 11,100$ MBq (300 mCi).

10. At what doses do you hospitalize?
11. At what doses do you recommend a stay in a hotel to avoid contamination of home?
12. At what doses do you recommend that the patient stay at home after treatment or after release from the hospital as an inpatient?

For questions 13–15, respondents were asked to indicate what human contact precautions were made for each of the dose ranges specified above for questions 10–12. The types of precautions queried included the following: avoid public transportation, avoid children under 2 years old, avoid children 2–10 years old, stay in hotel, sleep alone, avoid sexual contact, maintain specific distance with people, maintain specific time/distance exposure, breast feeding, use of potassium iodide to protect family members. Respondents could

also select that they do not advise a particular precaution and submit a write-in comment.

13. What human contact precautions do you advise on day 1 (first 24 hours) following I-131 treatment?
14. What human contact precautions do you advise on day 2 (24–48 hours) following I-131 treatment?
15. What human contact precautions do you advise on day 3 and beyond (over 48 hours) following I-131 treatment?

For questions 16–18, respondents were asked to indicate what hygiene precautions were made for each of the dose ranges specified above for questions 10–12. The types of precautions queried included the following: cleanliness: wash hands frequently; cleanliness: dispose of toothbrush; cleanliness: wash bedding and clothes separate from family; cleanliness: wash dishes separate from family; food preparation: don't make food for other people; food preparation: wear gloves to prepare food; toilet use: sit to void urine and always flush twice; waste/emesis clean-up. Respondents could also select that they do not advise a particular precaution and submit a write-in comment.

16. What hygiene precautions do you advise on day 1 (first 24 hours) following I-131 treatment?
17. What hygiene precautions do you advise on day 2 (24–48 hours) following I-131 treatment?
18. What hygiene precautions do you advise on day 3 and beyond (over 48 hours) following I-131 treatment?
19. Do you screen for pregnancy before giving I-131 to women? (always, sometimes, never, other-please specify)
20. After screening for pregnancy, how much time before giving I-131 treatment? (24 hours, 48 hours, other-please specify)
21. What exclusions do you allow for not screening in women of childbearing age? (hysterectomy, self-report of celibacy, no exclusions, other-please specify)
22. What tests do you use? (serum pregnancy test, urine pregnancy test)
23. Which do you require? (pregnancy test results, written consent of no pregnancy, verbal report of no pregnancy, none, other-please specify)

For questions 24–25, respondents were asked to indicate how long after I-131 to avoid child reproduction, for each of the doses specified above for questions 10–12. The answer selections included 1 month, 3 months, 6 months, 12 months, or that no routine recommendation was provided.

24. How long do you recommend that female patient avoid pregnancy after I-131 treatment?
25. How long do you recommend that male patients avoid fathering a child?
26. Do you use a consent form (yes/no)? If yes, does it contain information about avoidance of pregnancy (yes/no), breast feeding (yes/no), risk of malignancy (yes/no), risk to salivary glands (yes/no), other (please specify)?
27. Does insurance affect choice of outpatient versus inpatient care? (yes/no/other-please specify)